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Many “facts” have a long history of discovery, with a sometimes bitter and acrimonious debate before a final acceptance.

The study of knowledge even has a name, *Epistemology*, which investigates the “nature, grounds, limits or validity of human knowledge.” ¹

Consider the problems Giordano Bruno and Galileo Galilei had in the late 16th and early 17th centuries for advocating a view of the cosmos that was at odds with the Church’s doctrine that the earth was the centre of all creation. Giordano Bruno, a Dominican friar, who was burnt at the stake after 7 years of imprisonment, in 1600 for ‘holding opinions contrary to the Catholic faith’, which included that the earth was not the centre of all creation.

Galileo was “vehemently suspected of heresy” for advocating that the sun lies motionless at the centre of the universe, that the Earth is not at its centre and it moves”. He spent the last 8 years of his life under house arrest at his villa near Florence. Even though the four moons of Jupiter can be seen orbiting the planet, it was not sufficient to displace the biblical notion of the earth being the centre of creation.

Ignaz Semmelweis, a Hungarian doctor who reduced the mortality rate of mothers giving birth at Vienna General Hospital. In 1847, he was appointed an assistant in obstetrics at the teaching hospital. Women who gave birth that were attended by physicians and medical students had a death rate from infection of 13%–18% which was much higher than the 2% when delivered by midwives. He concluded that this resulted from the handling of corpses during autopsies before visiting the women. By introducing washing of hands with chloride of lime solution, mortality rate was reduced to 2%. After he introduced the washing of instruments the rate was reduced to 1%. ²

He had a similar success in his home town of Pest, in Hungary. Despite this he was subjected to ridicule and he died at the age of 47 in 1865. Consensus that cleanliness is a good idea is established two generations later with the work of people such as Louis Pasteur and Joseph Lister. Tens of thousands of mothers and their families suffered unnecessarily because of the reluctance to accept new ideas.

In *Life, the Universe and Everything* (part of the *Hitchhiker’s Guide to the Galaxy* series), Douglas Adams explains our inability to take in new information as a result of the *Someone Else’s Problem* field. Effrafax of Wug utilised the SEP field to create an invisibility device that

would run for a hundred years on a single torch battery. It relied on people's inability to see anything that they:

- do not want to,
- were not expecting or
- cannot explain

We obtain our information initially from parents and from interacting with the world around us. We learn that fire is something that should be avoided if we put our hand in it.

As we grow older, we learn from other people, reading, school, television. Observation is not always a reliable guide. It is obvious that the sun and the moon revolve around the earth - we see the sun rise each morning in the east and set at night in the west.

Causality - What does it mean to say an event causes an outcome?

Let's take smoking and lung cancer as an example. What does it mean when it is announced that "smoking causes lung cancer"?

For some people this means "smoking significantly increases the risk of developing lung cancer".

Others (particularly the tobacco companies) insist that it means "smoking always causes lung cancer". Most people can identify with a relative who smoked until she was in her 90s without any signs of cancer so the statement can easily be refuted. Frequently an additional criteria is added - "lung cancer is always caused by smoking". Since other factors play a part in lung cancer then this creates another opportunity to dismiss the "smoking causes lung cancer" argument.

This is the reason why tobacco companies were able to enlist scientists to announce that it has not been proven that smoking causes cancer even though strong evidence existed to link smoking with an increase in lung cancer risk.

The real world does not contain certainty - it is simply not possible to predict outcomes based on preceding events. Life is much more complex and unpredictable to allow for this kind of certainty. We can still make sensible decisions based on an element of uncertainty.

Whilst the statement "smoking does not cause lung cancer" may be strictly true, it is inadequate to describe the effect that smoking has on lung cancer and overall health.

Taking a strictly reductionist approach to life that is rich, complex and chaotic does not lead

to practical decisions.

We can also be trapped in believing that if an event is followed by an outcome then the outcome must be caused by the preceding event. May be it does - may be it doesn't. These beliefs can become very persuasive and difficult to dislodge even after it has been demonstrated that the two events are completely unrelated.

Studies relating to health and medicine

Observational Studies

Epidemiology is the study of the distribution and causes of health related states and events in a number of populations. An observational or ecological study observes the study groups without intervention.

The studies may be prospective - information is gathered and the study group followed for a number of years to determine if there are correlations between that observed facts and the later outcomes. It is possible that important information regarding the study was not gathered because it was not considered or was too expensive or complicated to gather.

A cross-sectional study looks at a snap-shot of the population at a point of time.

Examples of observational studies that relate to health include:

- *The Framingham Study* that showed the risk factors (high blood pressures, cholesterol values, fibrinogen, left ventricular hypertrophy, weight, and cigarette smoking) associated with heart disease.
- *Seven Country Study* showed that the major cardiovascular risk factors are universal, that diet is important factor in cardiac health and that cardiovascular disease is preventable and not an inevitable result of aging.
- *China-Cornell-Oxford Project* examined over 360 different health, lifestyle and nutrition factors and found over 8,000 significant correlations.
- Work of Sir Richard Doll and Sir Richard Peto that showed the link between smoking and lung cancer.
- *Seventh Day Adventist* studies showed significant correlations with health and 5 different categories of animal/vegetarian diets.

Sometimes epidemiological studies are considered weak evidence because, whilst they may show associations with different variables, that does not imply causation.

If the correlations can be explained by biological plausible reasons then additional credence for the correlation is warranted. If there is no known explanation, it is possible that it is simply because it has not been discovered yet.

A passionate criticism of *The China Study* was written by Denise Migner, an English major with no experience in epidemiology. She stated that a “highly significant correlation between wheat flour consumption and two cardiovascular diseases” for Tuoli County was omitted from the analysis.

Migner was implying the Colin Campbell deliberately ignored a relationship between wheat consumption and cardiovascular diseases. The Tuoli people are nomadic with a large seasonal variation in diet. At survey time they had a very high meat consumption but ate more vegetables and fruits when they migrate to the valleys. As a result, the data was excluded because it was unrepresentative of their diet as a whole.

It is important to note that the epidemiologist in the *China-Cornell-Oxford Project* was Sir Richard Peto, not Colin Campbell.

Migner also stressed that “none of these correlations (with wheat and heart disease) appear to be tangled with any risk-heightening variables.”

However, there were a number of highly significant confounding correlations which do affect the incidence of heart disease.

- There was a lower consumption of green vegetables,
- they consumed a relatively low intake of monounsaturated fats,
- had a greater body weight and
- had a high level of urea indicating high levels of protein intake.

Colin Campbell’s response indicated that there are no known and biologically plausible evidence to support a hypothesis that wheat causes these diseases.

Prospective Interventionist Experiments

Interventionist studies are commonly used to test a new drug, supplement or procedure.

Often these are random trials where both the subject and researcher are unaware if the subject is receiving the intervention.

If there is only one variable been changed, the goal is to be able to assert that A causes B.

This type of experiment is often considered the most highly regarded form of study. As a result, it offers greater funding opportunities.

It is almost impossible to have a dietary study where the participants are unaware of changes to the diet. Changes to diet involves the whole family. Participants and their families need to be committed to the idea of change and the reasons for them.

One concern that is frequently overlooked with random, clinical trials are the ethical issues. It is possible that a person could be significantly disadvantaged by being randomly assigned to a particular group in the study.

Case-Control Study

A retrospective study looks back to determine if events in the past have an impact on the current state of the population. This is more beneficial if you are seeking to determine the cause of a relatively rare event. It is impractical to wait for a long time to hope for an outcome that occurs infrequently.

It can be difficult (or impossible) to ensure that the recall of past events are accurate. How can we accurately recall what we ate or how long we spent in the sun without a hat 10, 20 or 40 years ago?

The *Case* cohort (the group of people who have the condition that is being studied) is matched and then compared with a *Control* group. This a group that is similar to the *Case* group but does not have the condition that is being studied.

It may be difficult to adequately match the two groups. How do we know which characteristics are important to be matched for the study?

How Truth may be Misrepresented

Cherry Picking - Selective Use of Data

When data is being gathered, it is important to validate the legitimacy of the data. Some data should be ignored because it is not valid. However, it may be tempting for researchers to ignore data, either deliberately or inadvertently, which does not fit their preconceived notions.

For example, Ancel Keys did not include data from northern Europe in his *Atherosclerosis: a problem in newer public health*³ paper of 1952. This was ignored because of the changes in diet during the Second World War. Death rate from heart disease fell in Northern Europe during the Second World War. Mexico was excluded because of the lack of a death certificate system. Untrained personnel were completing death certificates in Ceylon.

Another method of being selective is simply to ignore any evidence that is contradictory to the author's hypothesis or to use a group of self-referencing papers – papers with limited scope and a narrow research field, that serve only to superficially support an incredulous view.

Misrepresenting a referenced article - Lying

Another example is to selectively quote material from a journal article. Sometimes the referenced article's conclusion is actually opposed to that reported in the original article.

The only way to combat this is to have an extensive knowledge of the relevant literature, take the time to follow-up on as many references that are cited as possible. It is also helpful to have a basic knowledge of statistics.

For example, popular commentators frequently state that, Ancel Keys “gave sugar a clean bill of health”. Not so.

He wrote that he disapproved “of the common high level of sucrose in many diets.”⁴ He did state that sugar was not involved in heart disease.

In the book, *The Pioppi Diet*,⁵ Aseem Malhotra writes:

Now two thirds of people admitted to hospital with a diagnosis of acute myocardial infarction really have metabolic syndrome—but 75% of these patients have completely normal total cholesterol concentrations. Maybe this is because total cholesterol isn't really the problem?

Malhotra quotes a newspaper report for this information.⁶ The article quotes Dr. Gregg Fonarow from the UCLA, who states, “that the current guidelines [for cholesterol] may not be low enough to cut heart attack risk in most who could benefit”.

Having “normal” cholesterol levels when it is normal to die from a heart attack is not a healthy choice.

Malhotra completely misrepresents the newspaper article’s message, which is the cholesterol guidelines are too high. That is being dishonest.

Funding

It is important to determine the funding source of the study and the associations of the authors of the study. Researchers are reluctant to find adverse findings against the organisations which are funding the study.

Clair Patterson was a geologist who determined the age of the earth by studying the rate of decay of uranium into lead. He discovered the amount of lead in the atmosphere was much greater than it should be. It is largely though his efforts that legislation was enacted to remove lead from our environment. This was bitterly opposed by industry which actively fought against the removal of lead from products.

It is easier have papers published that report positive results rather than negative results. Journal receive income from reprints of articles. A paper that supports the use of a drug may generate hundreds of thousands of dollars in income.

Researcher’s Beliefs

In 1954, the Tobacco Industry Research Committee published a document *A Frank Statement to Cigarette Smokers*. It stated:

For more than 300 years tobacco has given solace, relaxation, and enjoyment to mankind. At one time or another during those years critics have held it responsible for practically every disease of the human body. One by one these charges have been abandoned for lack of evidence.

If your doctor or medical research was a smoker back in the 1960s when 60% of the population smoked then it would be difficult for a patient to find support to give up smoking.

The habits and beliefs of researchers has an impact on how their research studies are designed. Why look for evidence for the impact of smoking when you enjoy a cigarette after dinner? A researcher is less likely to find a problem with saturated fats if they like bacon and eggs or coconut oil. How can infection be prevented from spreading by washing hands if infection is caused by bad air (or miasma) as was the common belief for many centuries?

Sir Ronald Fisher was one of the founders and giants of statistical science. Yet in the late 1950s, he wrote passionately and extensively to dispel the myths that smoking was harmful. The fact that he was a smoker most likely had a great deal of influence on his views. He wrote in 1958, that:

Unfortunately, considerable propaganda is now being developed to convince the public that cigarette smoking is dangerous, and it is perhaps natural that efforts should be made to discredit evidence which suggests a different view.⁷

Animosity

Another possible guide to the presence of fallacious arguments is when a writer stops debating the issues and the writings become embroiled with personal attacks and generalisations.

One side may ask for clarification of a statement. Instead of a response to the query, statements such as “it is now accepted” and “it is now commonly understood” appear.

Clair Patterson (advocate for removal of lead from the environment), Rachael Carson (author of the *Silent Spring*) and Ignaz Semmelweis were subjected to vicious personal attacks.

Cultural Myths and Paradigms

Cultural viewpoints are frequently accepted without much consideration. They are so much a part of our lives that it is difficult to see that they may not be true. The definition of concepts can colour our views.

The *French Paradox* is widely quoted as evidence that saturated fats and heart disease link is, if not invalid, is somewhat dubious. According to a paper in *The Dialogues of Medicine-Vol 13 No 3 2008*⁸, the French paradox is indeed a myth.

The clear conclusion, driven by the facts as summarized by Pierre Ducimetière, is that the rates of CHD are not so low in France, animal fat intake is not so high, and the diet-heart concept is not so unique that the existence of a “French paradox” can be sustained, except for satisfying cultural fantasy or for wine enthusiasm and marketing. Thus, the real paradox is why the French paradox continues to exist as a concept, when it should be replaced by the less

mystifying view, namely, “the more Mediterranean, the better”.

The *Butterfly Effect* refers to the concept that small changes can have a large impact on the final result. It is often quoted as “a flap of a butterfly’s wings in Brazil will set off a tornado in Texas”.

Edward Lorenz was a mathematician and meteorologist. In 1961, he was examining the results of his weather forecasting model which took in to account changes in temperature, pressure, wind speed and direction. He re-entered the data, to run the results again, leaving out the last 3 decimal digits. The results were consistent with the first run for some period then they diverged substantially.

One meteorologist friend, Phil Mears, remarked that “if the model is correct, one flap of a seagull’s wings could change the course of weather forever.”

In 1972, Lorenz presented a talk *Does the flap of a butterfly’s wings in Brazil set off a tornado in Texas?* It was a question. The answer is – of course it does not. Lorenz conclusion was that long-term weather forecasting was doomed.

The question became a statement known as the *Butterfly Effect*. Yes, a small single decision may have a big on our lives but not because of the actions of a single butterfly.

Why is “*Left*” and “*Right*” reversed in a mirror and “*Top*” and “*Bottom*” is not? This is most obvious when we look at writing in a mirror. **W**, **M**, **V** and **A** are the same shape when viewed in a mirror. However, the letter **E** becomes **Ǝ** – left and right is reversed, but not the top and bottom.

It is because of our definition of left and right is different from our definition of top and bottom. Walk around the opposite side of a tree then the left side becomes right. Our view of the world is dependent upon our definition of these 4 concepts.

Truth and Significance

Even if a fact is true, it does not necessarily mean that it is significant when taken in context.

Ranexa⁹ was studied in patients with chronic angina who still had symptoms despite being treated with other angina drugs. Patients taking Ranexa experienced a reduction of 22% of

angina pain. It does sound impressive.

565 patients who were experiencing about 4.5 episodes of angina a week were randomly assigned to take either Ranexa or a placebo for six weeks.

Patients receiving Ranexa had a reduction in angina of about one episode per week, compared with those in the placebo group.

A reduction from 4.5 episodes a week to 3.5 episodes a week is not going to change the quality of life, especially given that common side effects included dizziness, headache, constipation, and nausea.

When examining the validity of a statement, all relevant information needs to be taken into account including the relative and absolute changes to the data. The impact of an intervention, both short-term and long-term needs to be considered.

It is not easy to determine the difference between a fact and an opinion. Our own biases and world-view may conflict with new information that we receive.

It is difficult for us to change our strongly held views – this is equally true for researchers as well as those who are reading their words.

**The foolish reject what they see, not what they think;
The wise reject what they think, not what they see.
Huang-Po, Zen Buddhist (d 850)**

Footnotes

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